expect the most notable displays in the evenings about the vernal equinox having thus been by no means justified in the result. The light was perceptible for a short time last Sunday evening, without any yellowish tinge, and the position of axis somewhat doubtful from the indifferent state of the sky. Prof. Heis's observations in December from 1851 to 1870, place the mean position of the apex on the equator in R.A. 349°, or with about 82° elongation from the sun: this refers to the eastern arm of the phenomenon.

THE RAINFALL

THE extraordinary rainfall of the past year will make 1875 memorable in the annals of meteorology. With scarcely an exception every part of Great Britain has suffered from a plague of rain; from the Continent and from North America there come the same tidings of incessant rain and vast inundations. Even in a country so far distant as China we hear of unprecedented rains. The following statistics concerning a rainfall that occurred in China between last August 31st and September 1st will be read with astonishment. Our information is derived from the bulletins of the Meteorological Observatory of the Fathers of the Society of Jesus at Sikawei, on whose accuracy of observation we may doubtless depend. The readings show that between four and seven o'clock in the morning of September 1st the mean rainfall per hour was 32·7 millimetres, which makes the astonishing rate of 1·287 inch for each of those three hours. Well may the compiler remark, "We think there are few examples of such a figure, except in the case of waterspouts."

The total quantity that fell in the garden of the Jesuit Observatory during the twenty-four hours that elapsed between four o'clock on Tuesday, 31st August, and the same hour in the afternoon of Wednesday, 1st September, was 218 millimetres, or no less than 8·59 inches for the rainfall of a single day! After this the records of rainfall in Great Britain look insignificant. Nevertheless the fall has far exceeded the ordinary statistics. At Balbriggan, a town a few miles north of Dublin, the rainfall from 9 A.M. on the 13th inst. to 9 A.M. on the 14th inst. was two inches. This is the greatest fall in twenty-four hours which occurred in that town for the last ten years.

It is important to obtain statistics from the southern hemisphere. It is probable a vast drought must somewhere compensate for the floods of water poured over a large part of the northern hemisphere.

THE WORK OF THE CHALLENGER[*]

THIS report is dated from Hilo Hawaii, August 18, and describes the cruise of the *Challenger* from Yokohama to the Sandwich Islands. The *Challenger* left Yokohama on the 16th of June, and ran an easterly course between the parallels of 35° and 40° north latitude, as far as the meridians of 155° east. She then turned nearly directly southwards and reached Honolulu on the 27th of July. Twenty-four observing stations were established, at each of which most of the desired observations were made.

On the 17th of June, Prof. Thomson's Report goes on, we sounded in 1,875 fathoms with a bottom of bluish-grey clay and a bottom-temperature of 1°·7 C., forty miles to the south-east of No Sima Lighthouse. The trawl was put over, and it brought up a large quantity of the bottom, which showed the clay was in a peculiar concretionary state, run together into coherent lumps, which were bored in all directions by an Annelid of the Aphroditacean group. In many cases the Annelids were still in the burrows. Among the clay there were large lumps of grey pumice. The hyoid zoophytes were represented by a very remarkable species, apparently referable to the genus *Monocaulon* of Sars, a Corymorpha-like solitary polyp with adelocodonic gonophores; but instead of being of the proportions usual in its group, the stem in one of our specimens measured upwards of seven feet in height, while the polyp-head was nine inches in diameter across the proximal row of tentacles. We afterwards got another fine example of the same species at a depth of 2,900 fathoms (Station 248). The temperature of the surface of the sea stood during the day at nearly 23° C., considerably above the temperature of the air; and a serial sounding gave the isotherm of 10° C. at a depth of little more than 200 fathoms. We were therefore evidently under the thermic influence of the Japan current, which was found by observation to be running in an easterly direction at a rate of 1½ knots an hour. The thermometers registered a uniform temperature of 1°·7 C. from a depth of 1,000 fathoms to the bottom. About twenty Albatrosses of a nearly uniform brown plumage with whitish heads, probably the young of the common North-Pacific species in their second year's plumage, followed the ship.

On the following day there was a stiff breeze from the southward, and with a heavy sea. We sounded, however, successfully in 3,950 fathoms, our deepest sounding in the North Pacific position by dead reckoning lat. 34° 43′ N., long. 144° 2′ E., with a bottom of "red clay." The high surface-temperature continued to be maintained; and the position of the isotherm of 10° C., at station 239 at a depth of nearly 300 fathoms, indicates that up to this point, at all events, there was no diminution in the influence of the "Kuro-Siwa."

On the 21st the temperature-observations gave a singular result. The surface-temperature had fallen to 18°·2 C., and the belt of water above 10° C. was reduced in depth to considerably below 100 fathoms, while all the isotherms, at all events to a depth of 400 fathoms, rose in proportion. There seems to be little doubt, from a comparison of the American temperature-results with our own, that this sudden diminution of temperature is due to a cold surface-flow from the Sea of Okhotsk, probably through Pico Channel or Vries Strait. Very likely its effect may not be found to be constant; and at this season it possibly attains its maximum from the melting of the snow over the vast region drained by the Amoor and the Udi and Siberian rivers with a southern outflow.

On the 26th of June we sounded in 2,800 fathoms. Several forms were met with which apparently do not occur on the surface, particularly a number of species of a group which is so far as we know entirely undescribed. It seems to be intermediate between the Radiolarians and the Foraminiferas, resembling the former in the condition and appearance of the sarcode and in the siliceous composition of the test, and the latter in external form. The broken tests of these organisms are extremely abundant in the "red clay" soundings; a sufficient number of observations has not yet been made to enable us to say with certainty what is their bathymetrical distribution. From a zoological point of view the haul of the 28th was remarkably successful; there were one or two fishes, a *Scalpellum*, a number of annelids, particularly a prominent aphroditacean; Echinoderms of the genera *Pourtalesia*, *Archaster*, *Brisinga*, and *Antedon*; a fine species of *Cornularia*, several examples of *Fungia symmetrica*, and some *Actiniæ*. The general distribution of temperature remained much the same, the isotherm of 10° C. retaining its position near the 200-fathom line.

We trawled on the 2nd of July in 2,050 fathoms with a bottom of light brownish ooze with many *Globigerina*-shells. The bag brought up a number of lumps of pumice, and among them a very characteristic assemblage of deep-sea animals, the most interesting an undescribed species of *Hyalonema*, which occurred in considerable numbers and in an excellent state of preservation. The form of the sponge-body is almost spherical, with a comparatively small oscular opening, and the coil is much shorter than in *H. Sieboldi*, in the largest specimens not more than six inches in length. One remarkable point was, that in no case was there a commensal *Palython* connected with this sponge; the coil was always perfectly clean. The spicules of the network and of the sarcode closely resemble those of the Japanese species, but they all present marked specific differences in detail of form.

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[*] Abstract of "Report to the Hydrographer of the Admiralty on the Cruise of H.M.S. *Challenger* from June to August 1875," by Prof. Wyville Thomson, F.R.S., Director of the Civilian Scientific Staff on Board. Read at the Royal Society Nov. 18.

On the 12th of July the trawl was lowered at a depth of 2,740 fathoms. The net contained very few animals, and was greatly torn and frayed; but in a kind of packet formed by an accidental folding of the net, there were about a hundredweight of black mammillated concretions, which, when they were poured out on the deck, had very much the appearance of potatoes. The external surface of the concretion was slightly rough, and a number of small animal forms, particularly a minute rhizopod in a membranous tube, nestled in the crevices. The nature of these concretions will be discussed hereafter.

On the 14th of July we reached the point lat. 38° 9′ N., long. 156° 25′ W., whence we turned southwards towards the Sandwich Islands. For the last few stations the temperature of the water had been gradually sinking, and the influence of the Japan current dying out; the isotherm of 10° C. was now only 100 fathoms below the surface.

On the 17th of July we sounded in 3,025 fathoms, the bottom still "red clay;" and on the 19th in 2,850 fathoms. A serial sounding taken at the latter station to 1,500 fathoms showed a considerable rise in the temperatures near the surface, the isotherm of 10° C. having again sunk to a depth of 200 fathoms, and that of 15° C. corresponding with the 100-fathom line.

On the 24th, in 2,775 fathoms, the Albatrosses which had followed the ship, to the number of from fourteen to twenty daily since we left Japan, left us. In the evening of the 27th, the *Challenger* anchored in the harbour of Honolulu.

This cruise naturally divides itself into two parts: a section about 3,170 nautical miles in length, including the stations from No. 237 to No. 253, very slightly to the northward of east, between the parallels of 35° and 38° N. lat.; and a meridional section of 1,128 nautical miles, along the meridian of 155° W. long. The first of these sections corresponds very closely in relative position with the section in the Atlantic between Sandy Hook and the Açores, and the points of resemblance and difference between them, when fully worked out, must prove most instructive. The two sections cross the two great deflections to the northward of the equatorial current, in the Atlantic the Gulf-stream, and in the Pacific the "Kuro Siwa;" and the thermic influence of the two currents is fairly contrasted. The influence of the Gulf-stream, if not absolutely greater (and this is a point which it will be somewhat difficult to determine), is at all events much more concentrated and effective, owing to the continuity of the coast-line of the American continent, to the way in which the water of the equatorial current is driven into the Gulf of Mexico and superheated there, afterwards to be kept together and ejected in a defined stream through the Strait of Florida, and to the absence of periodical winds in the Atlantic. In the Pacific, on the other hand, the main flow of the equatorial current is weakened among the passages of the Malayan Archipelago; and although a large part of it is directed northwards by the broken barrier formed by the Fiji Islands, the New Hebrides, and Papua, it almost at once enters the region of the Monsoons, where it is thwarted for half the year; and it can only be regarded as comparable with that portion of the reflux of the Atlantic equatorial current which passes outside the West Indian Islands. It passes the south coast of Japan nevertheless as a very palpable and apparently a permanent current, exercising a very perceptible thermic influence to a depth of at least 300 fathoms.

In traversing the Pacific the influence of the Japan current appears to be gradually lost, while I am still inclined to believe that in the Atlantic the Gulf-stream is banked down against, and reflected from the western coast of Europe. It is a question of great complexity; but it seems to me that it is consistent with our experience that the temperature of the water of the ocean at any one place is due in a great measure to the temperature of the source of that water—not entirely due, for in passing through a long distance the temperature of even the greatest masses of water is certainly gradually altered by conduction and mixture.

The suggestions of Dr. Carpenter and Mr. Buchanan that the existence of a deep layer of warm water in the Atlantic might be connected in some way with the mean annual temperature of the area, and the absence of ocean-currents, are very suggestive; and I looked forward with great interest to an opportunity of testing them in the corresponding position in the Pacific. But there seems to be no trace of anything of the kind; as the influence of the equatorial reflux becomes weaker the temperatures fall uniformly.

To show that the conditions in the two oceans differ more in degree than in kind, I give in Plates I. and II. curves constructed from serial soundings along nearly corresponding lines in the Atlantic and Pacific. Curves A and B are added on Plate I. to show the position of the deeper belt of abnormally warm water, which makes its appearance near the coast of Europe.

Plate I.

No. of Station.	North Atlantic Ocean.		Depth in fathoms.
	Latitude.	Longitude.	
	° ′	° ′	
43	36 23 N.	71 51 W.	—
44	37 25 ,,	71 40 ,,	1700
53	36 30 ,,	63 40 ,,	2650
65	36 33 ,,	47 58 ,,	2700
69	38 23 ,,	37 21 ,,	2200
71	38 18 ,,	34 48 ,,	1675
80	35 3 ,,	21 25 ,,	2660
A A	In the Bay of Biscay.		2090
B B	Off the coast of Portugal.		1090

Plate II.

No. of Station.	North Pacific Ocean.		Depth in fathoms.
	Latitude.	Longitude.	
	° ′	° ′	
237	34 37 N.	140 32 E.	1875
240	35 20 ,,	153 39 ,,	2900
243	35 24 ,,	166 35 ,,	2800
245	36 23 ,,	174 31 ,,	2775
246	36 10 ,,	178 0 ,,	2050
248	37 41 ,,	177 4 W.	2900
252	37 52 ,,	160 17 ,,	2740

There seems to be little doubt that the enormous mass of cold water which fills up the trough of the Pacific is like the cold bottom-water of the Atlantic, an indraught from the Southern Sea. The more the question is investigated the less evidence there seems to me to be of any general ocean circulation depending upon differences of specific gravity. It seems certain that both in the Atlantic and in the Pacific the bottom-water is constantly moving northwards; and I am now very much inclined to refer this movement to an excess of precipitation over the water-hemisphere, a portion of the vapour formed in the northern hemisphere being carried southwards and precipitated in the vast southern area of low barometric pressure. I hope to enter fully into the discussion of this matter on a future occasion. The temperature of the water is greatly lower in the Pacific for the first thousand fathoms than in the Atlantic in the corresponding latitude of 35° N. There is one very remarkable difference between the two basins. While in the Atlantic it seems certain that the temperature sinks gradually, though very slightly, for the last thousand fathoms to the bottom, it appears that in the Pacific the minimum temperature of 1°·7 C. is reached at a depth not greater than 1,400 fathoms, and that from that depth to the bottom the temperature is the same.

The soundings from Yokohama to Honolulu are remarkably uniform in depth, the twenty-two soundings on one line which are unaffected by the neighbourhood of land giving an average of 2,858 fathoms. The nature of the bottom is also very uniform; and, according to the nomenclature which we have adopted, it is in each case noted on the chart as "red clay." It is usually, however, somewhat greyer in colour than the typical "red clay," and contains a large proportion of the tests of siliceous organisms, a proportion which increases with increasing depth, and a considerable proportion of pumice in different states of comminution and decomposition. The clay contains scarcely a trace of carbonate of lime, although the surface swarms with ooze-forming foraminifera. In some cases the trawl came up half full of large lumps of pumice, which seemed to have been drifted about till they were water-logged, and to be softening and becoming decomposed; these pieces of decomposing pumice were often coated and pervaded throughout with oxide of manganese. Over the shale area the red clay was full of concretions, consisting mainly of peroxide of manganese, round, oval, or mammillated and very irregular, varying in size from a grain of mustard-seed to a large potato. When these concretions are broken up, they are found to consist of concentric layers having a radiating fibrous arrangement, and usually starting from a nucleus consisting of some foreign body, such as a piece of pumice, a shark's tooth, or a fragment of any organism, as for instance in one case a piece of a Hexactinnelid sponge, of the genus *Aphrocallistes*, which was preserved as a very beautiful fossil in the centre. The concretions appear to form losse among the soft clay; the singular point is the amount of this manganese formation, and the vast area which it covers.

We were particularly successful during this cruise in getting good samples of the fauna from great depths; and we found that the fauna of the North Pacific at depths of from 2,000 to 3,000 fathoms, although not very abundant in species, is by no means meagre. For each of six dredgings and trawlings at depths greater than 2,000 fathoms, we found along with a few fishes a fair representation of all the larger invertebrate groups; and in one dredging, No. 253, at a depth of 3,125 fathoms, we took a small sponge, a species of *Cornularia*, an *Actinia*, an annelid in a tube, and a Bryozoon. We were again struck with the wonderful uniformity of the fauna at these depths; if not exactly the same species, very similar representatives of the same genera in all parts of the world. I am glad to be able to report that everything is going on in a satisfactory way in the departments under my charge.

ACOUSTIC CLOUDINESS

WHEN the weight and number of the guns in action are taken into account, the following extract from "My Experiences of the War between France and Germany," vol. ii. pp. 285-9, by Archibald Forbes, will probably be regarded as the most extraordinary instance of "acoustic cloudiness" hitherto recorded. The complete reversal of the optical and acoustical conditions on two succeeding days renders the case very perfect. I am indebted for the extract to the obliging kindness of Mr. James Kenward, of Birmingham.

"The morning of the 6th presented a remarkable contrast in every respect to that of the preceding day. The latter had been cold to the chilling of the marrow, and so thick that nothing was to be seen half a mile away. The former was clear, bright, and warm as a morning in the end of March. Yesterday the air was charged with sound; to-day there reigned the stillness of an Arcadia that knows not war. Men looked at each other in blank amazement. Had Paris, forts, big guns, bombardment, and the no-bombardment on the eastern side alike been spirited away? Had the French reply shut up our pretty Spandau toys in one day? Or, on the contrary, had those pieces of finished mechanism stove in the forts and batteries bodily? And if we were going up to Montmorency, should we see the white flag on the top of Montmartre in token that all was over? Men were reticent in expressing speculations, but at the corners of the straggling lanes of Margency I heard the words 'Capitulation,' 'Parlementaire,' muttered as the feldgensdarmes and the orderly-men gossiped in little groups. Making the best of my way to head-quarters, I found head-quarters in ignorance and suspense. Nobody could interpret this strange, ghostly silence. There had come from Versailles on the previous night a telegram stating that the King was well pleased with the results which the day's bombardment had achieved. So it was plain the silence was not on our part due to coercion. 'Negotiations, then?' I suggested to my friendly interlocutor. 'No, that cannot well be,' was the reply, 'since in that case we should have received instant instructions to silence our Maas Army batteries, and this has not been the case.' 'Are they firing, then?' I asked, for it might be that I had been struck with sudden deafness. 'No, it would seem not, I can hear nothing. The silence is a puzzler, but we are sure to hear all about it within a few hours.' Determining to anticipate by personal investigation the information which was kindly promised me, I rode off to the front of Montmorency, whence there lay spread before the eye the wide panorama of the north side of Paris. Still all was silent as the grave. There was the white foreground, the ice-bound river, and the St. Denis chimneys smoking lustily according to their wont. Neither from the east nor the west came there the slightest sound of firing. A slight haze-bank hung over Le Bourget, which might have been snow, fog, or the filmy smoke of a cannonade; but, if the latter, it must have surely been audible. There I found three mounted officers, and we had a little talk about the position. They inclined to the armistice-negotiations theory, more especially as they had not heard a single shot since morning. As we spoke, there came a white jet of smoke out of the grey side of La Briche. No sound; for all the noise it made it might have been an escape of steam. But in a second or two we did hear something—the close swish of the shell, and then the explosion about fifty yards to the right. La Briche could not resist the temptation of the group. 'No negotiations, then, that is certain,' was the remark as we broke up and went our several ways.

"This action of La Briche rather intensified the puzzle, because it seemed to knock away the only explanation. I could not go to the south, but I could visit the batteries about Pont Iblon, and get at the root of the matter.

. . . .

"I came on to Gonesse alone. What was my surprise to find all the German batteries from Gonesse to Sevran firing away vigorously! They had been at it since eight in the morning. In Gonesse I learned that the firing on the south side was believed to have recommenced at the same hour, and was certainly going on. Yet at Margency and Montmorency we could not hear a sound. It was all owing to the air; it was to-day as non-conducting of sound as it had been the reverse yesterday. Even in Gonesse we could not hear the guns that were thundering, so to speak, at our elbows."

The condition of things here so graphically described discloses a state of the atmosphere precisely similar to that existing at the South Foreland on the 3rd of July, 1873. There, as here, the belching of the smoke from